

# Human Autonomy Teaming m:N Operations

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# A few (not all) problems with **many** current automation implementations

- **Brittle**
  - Automation often operates well for a range of situations but requires human intervention to handle boundary conditions (Woods & Cook, 2006)
- **Opaque**
  - Automation interfaces often do not facilitate understanding or tracking of the system (Lyons, 2013)
- **Miscalibrated Trust**
  - Disuse and misuse of automation have led to real-world mishaps and tragedies (Lee & See, 2004; Lyons & Stokes, 2012)
- **Out-of-the-Loop Loss of Situation Awareness**
  - Trade-off: automation helps manual performance and workload but recovering from automation failure is often worse (Endsley, 2016; Onnasch, Wickens, Li, Manzey, 2014)

# HAT Principles (Not Exhaustive) (Pros and Cons)

- Bi-directional Communication
- Transparency
- Shared situation awareness (mental model)
- Pilot directed interface
- Meaningful Human Control

# M:N Aircraft Operations



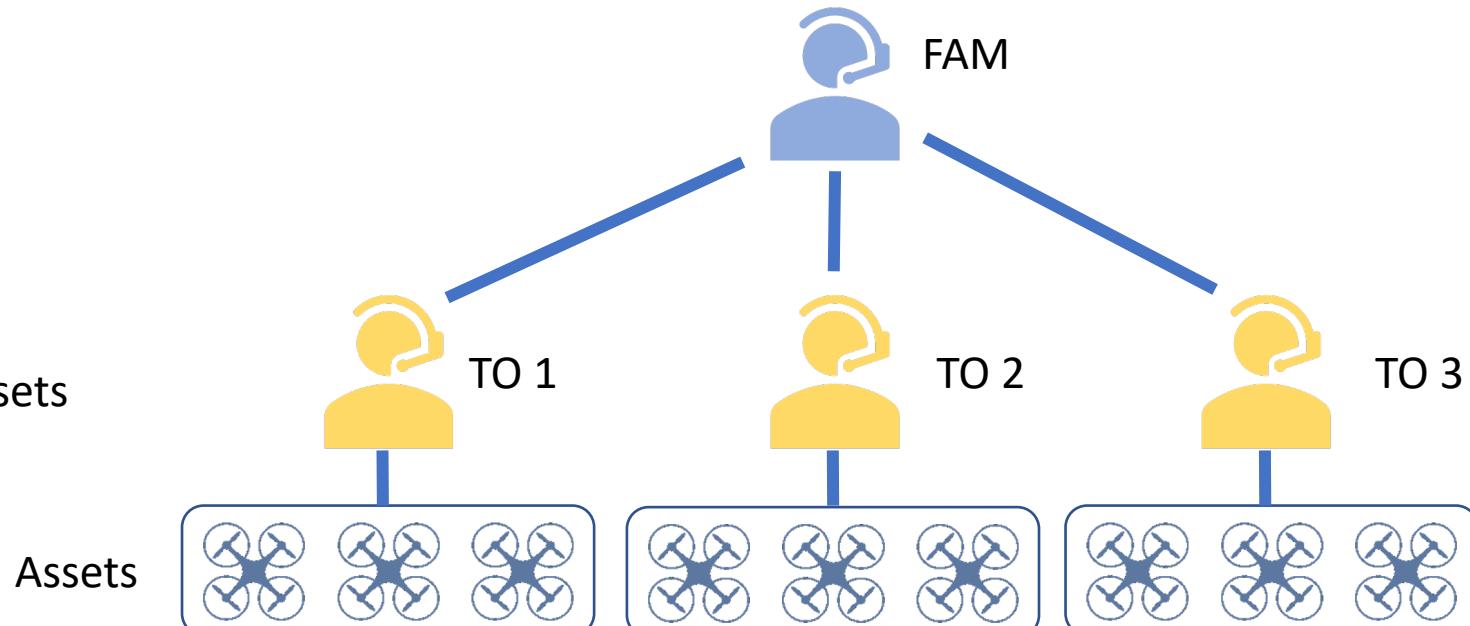
# M:N Configuration

- m:N Paradigm

- Multiple operators to multiple vehicles, where:
    - m = # of operators
    - N = # of vehicles

- Roles in m:N operations:

- Tactical Operator (TO)
    - Pilot-in-Command (PIC) of multiple assets
    - Monitors airspace and hazards
    - Attends to assets
  - Fleet Area Manager (FAM)
    - Responsible for overseeing a select number of TOs in a specific area
    - Monitors fleet health and system health
    - Evaluates TO performance and workload online



# m:N Working Group ([please join us](#))

- Initiated by Andy Thurling, NuAir and myself – JAN 2021
  - Quarterly meetings
  - 50 – 75 attendees; gov’t, industry; research, operations
  - Sub-groups
    - Large auto-cargo, UAM, small UAS, HAPS, Swarms
- Working group
  - Identify Barriers and share solutions/lessons learned
  - Advocate for m:N operations
  - Standards Organizations
    - RTCA SC-228 DAA Use cases
  - Develop operational approval roadmap

# M:N Activities (HAT Lab)

## Human in the loop simulations

- Roles and responsibilities
- Hand-offs
- **Communication**
  - UAM (Wisk, Joby) (1:4, 2:20)
  - Small autonomous (Zipline) (1:15 – 20, 2:50)
    - DAA, contingency mgt – drivers
  - Fall 2022, Spring 2023
- Operational environment
- V & V



# Summary

- Automation as a TEAMMATE
- Basic Principles
- Instantiate in m:N domain
- Working closely with industry partners to ensure operational significance and adoption